



Wicetec Ice Prevention System

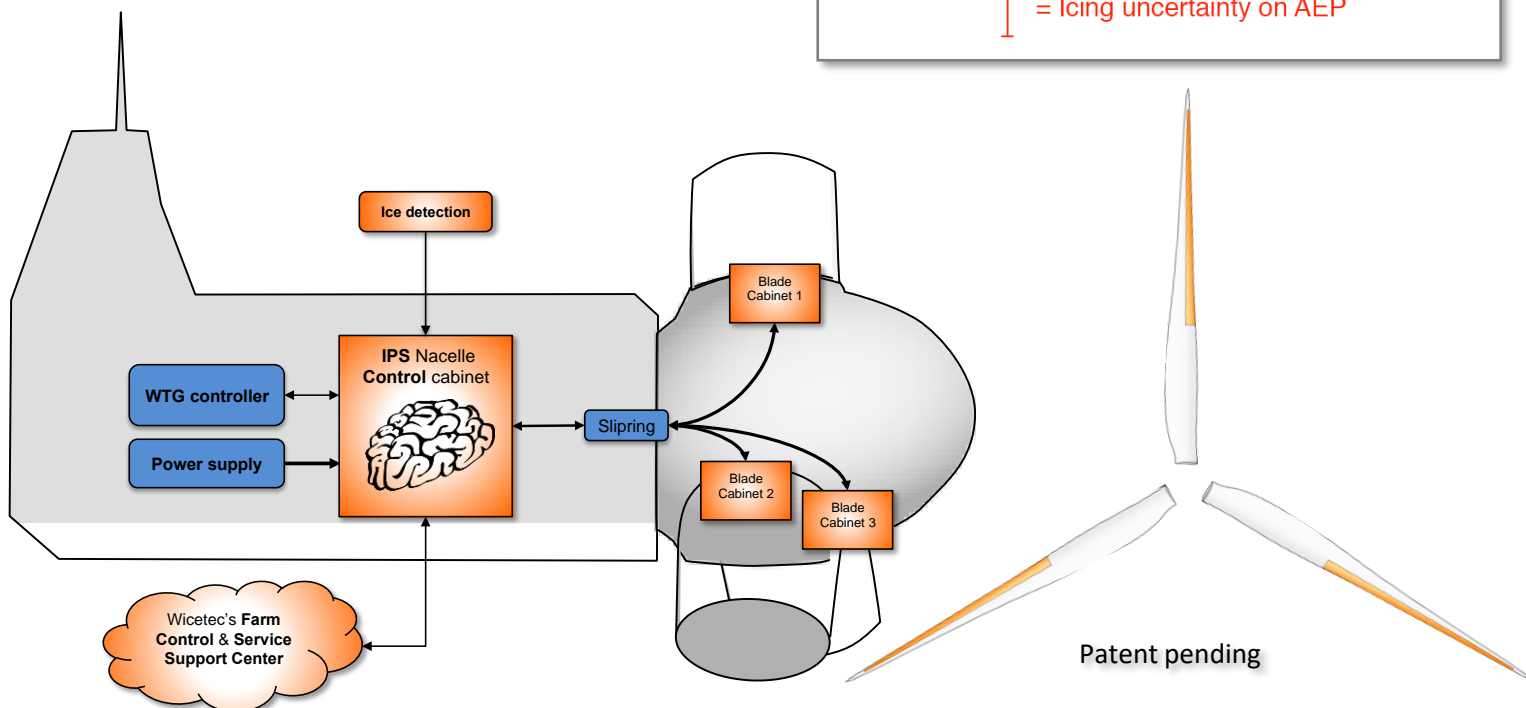
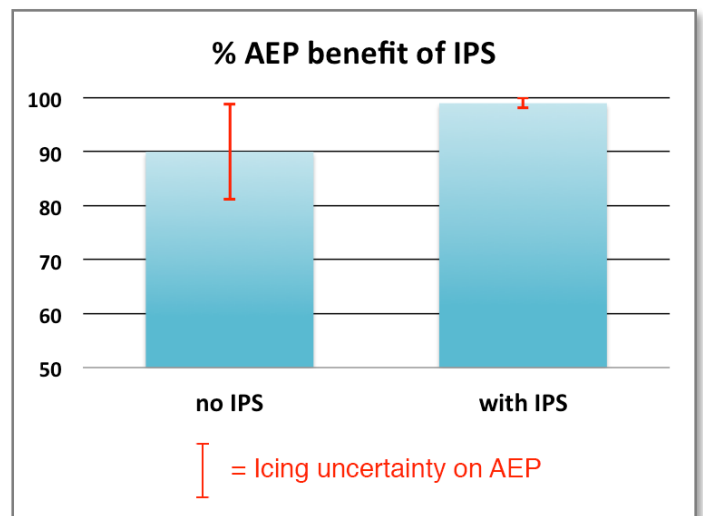
Wicetec Ice Prevention System for wind turbines increases a wind turbine's availability in areas where atmospheric icing occurs. Moreover, the increase of availability happens when winds and electricity prices are highest, which lead to **increase in energy production and revenues**.

Benefits

Wicetec Ice Prevention System keeps blades free of ice and thus the wind turbine can operate as it is designed through the winter giving benefits:

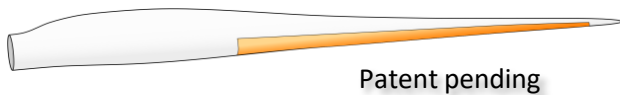
- Project development phase: reduced uncertainty of Annual Energy Production (AEP) improves financing of the project.
- Operational phase: increased availability yields improved AEP and accuracy of production forecasting.
- Operational phase: reduced maintenance costs for blades and other components, like bearings and drive train.

Example case: Energy gained with IPS.
Annual icing time 10% (36 days).



IPS Heating elements (patent pending)

The **effective** electro-thermal heating elements are made of carbon fabric with **suitable mechanical properties** for the loads in wind turbine blades. The carbon fabric heating elements enables **high power density** which is required in anti-icing operation. Temperature of heating elements is controlled and there is not risk of overheating of blade.



Patent pending

The heating elements are assembled in blade factory as a part of the blade manufacturing process. In this way **high quality** is achieved in terms of **electrical properties** and blade **aerodynamics**. In case of a blade damage the heating element is reparable.



Lightning protection

Lightning protection of IPS is coordinated together with the blade and wind turbine lightning protection. Wind turbine lightning protection have to fulfill requirements of IEC 61400-24 standard to incorporate IPS successfully. Control and blade cabinets and cabling are protected according to IEC 62305 series.

Contact information:

Petteri Antikainen, CEO
+358 405 890 104
Petteri.antikainen@wicetec.com

Tomas Wallenius, CTO
+358 400 174 953
Tomas.wallenius@wicetec.com

Ice Prevention System requirements	
Power requirement	Anti-icing design: 60...100 kW, De-icing design: 25...35 kW
Energy consumption	0.3% of Annual Energy Production
Ice detection	Commercial ice detector(s) Combination of other weather signals
Communication	Industrial communication between IPS and WT Remote connection to Service Support Center

Track record of the IPS technology

- = Constructed/licensed in pre-Wicetec era
- = Wicetec license/delivery

Research installations:			
Site Location:	Size:	Year:	OEM:
Pyhänturi (FI)	2.5 kW	1991	-
Jyppyrä (FI)	65 kW	1993	Nordtank
Pyhänturi (FI)	220 kW	1993	Wind World
Total	0.28 MW		

Demonstration and Commercial installations:					
Location:	WTGs [number / MW]		Year	OEM	Owner
	Lammasoivi (FI)	2			
Olostunturi & Lammasoivi (FI)	6	0.6	1998-99	Bonus	
Suurva & Rodåvålen (SE)	2	0.6	1998	Bonus	
Pori & Kotka (FI)	6	1	1999	Bonus	
Uljabuouda (SE)	10	3	2009-10	Winwind	SKAB
Jokkmokksliden-Storliden (SE)	17	2.5	2010-11	Nordex	SKAB
Blaiken I & II (SE)	60	2.5	2012-13	Nordex	SKAB/Fortum
Sites in Sweden	10	2.5	2012-14	Nordex	
Sites in Finland and Sweden	67	3	2013-16	Nordex	
Sites in Finland and Sweden	39	3	2017	Nordex	
Tornio (FI)	1	4.5	2016	Gamesa	
Blaiken III (SE)	30	2.5	2015	Dongfang	SKAB/Fortum
Blaiken IV (SE)	9	2.5	2016	Dongfang	SKAB/Fortum
Lac Alfred (Quebec, Canada)	2	2	2016	Senvion, Retrofit	
China (CN)	1	2.5	2017	Envision	
Ulyanovsk (RU)	14	2.5	2017	Dongfang	Fortum
Lac Alfred (Quebec, Canada)	10	2	2017	Senvion, Retrofit	
Total	286	741			